DOCUMENT RESUME

ED 217 866 IR 010 251

AUTHOR Neill, Michael J.
TITLE Recommendations for Implementing Computer Literacy in Oregon Secondary Schools.
INSTITUTION Oregon State Dept. of Education, Salem.
PUB DATE Sep 76
NOTE 13p.

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Literacy; Computers; *Educational Assessment; *Educational Objectives; Educational Resources; Elementary Secondary Education; Higher Education; *Secondary Schools; Statewide Planning; Teacher Education; Technological Advancement
IDENTIFIERS *Oregon

ABSTRACT

This study, undertaken for the Oregon Commission on Computers in Education, first addresses the reasons for undertaking a computer literacy program in Oregon's secondary schools and then provides a brief synopsis of the status of computer education in the state. The rationale for the study of computer technology and the impact of computers upon society is discussed. Recommendations for defining and assessing computer literacy as a discipline, for placing computer literacy within the context of existing course goals, and for the training of teachers in computer literacy are presented. Computer resources available to Oregon schools are then identified. A 31-item bibliography accompanies the text. (Author/JL)

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ED217866

Recommendations for Implementing Computer Literacy in Oregon Secondary Schools

by
Michael J. Neill
for
The Commission on Computers in Education,
Oregon Board of Education
September 1976

IR010251

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INTRODUCTION

This study was undertaken for the Oregon Commission on Computers in Education: (1) to establish that the study of computer technology and its impact on society is consistent with the competency based educational program in Oregon and (2) to outline the resources and training needed to implement a computer literary program and to list some of the resources available in Oregon to assist with the task.

Several years ago, the Oregon Board of Education adopted requirements that students graduating from Oregon High Schools be competent in areas of personal development, social responsibility, and career development. That is, students must demonstrate the achievement of local district and state approved "survival level skills" in these three areas. A primary question addressed in this document is: which objectives might a local district wish to adopt in order to help its graduates survive a computerized society?

The Commission on Computers in Education has been formed to establish standards for computer use and to assist LEAs in planning, implementing, and evaluating computer instruction. One goal of the Commission is to establish guidelines for computer literacy. The document [1] which guides the Commission defines computer literacy as

> "awareness, attitudes, and knowledge necessary to understand the effects of the computer on society. It is essential that everyone be cognizant of the capabilities and limitations of the computer and be attuned to the social, vocational and governmental implications of the increasingly widespread utilization of computers."

The Commission has requested that an effort be initiated to operationalize this definition in Oregon School Districts. The process of bringing about a computer literacy program will involve careful definition of program objectives, agreement upon program needs by interested parties, such as parents, teachers, etc., assessment of learner competencies, dissemination of these through a curriculum guide and definition of teacher training programs.

This paper will first address the reasons for undertaking a computer literacy program and provide a brief synopsis of the status of computer education programs in Oregon. It will then outline a procedure for defining and assessing computer literacy and make recommendations to the Commission for follow-up activities in the area of curriculum development and teacher training.

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[1] Statewide Plan for Educational Computer Services in Oregon available from Department of Education, 942 Lancaster Drive N. E., Salem, OR 97310

Appended to the paper are, (1) a list of course competencies which can be inserted into existing State Department graduation requirement publications to modify their recommendations (2) a rating scale used in a study to define computer literacy (3) sample teacher training programs, (4) reprints of documents on careers in the computer field (5) a newspaper article on how an existing occupation may be changed by computer technology.

RATIONALE

A host of authors and committees have studied the intrusion of computer technology into our lives. Martin and Norman [19], Taviss [30], Taviss and Burbank [31], Sackman and Borko [27], Gotlieb and Borodin [14], Dorf [9], and Rothman and Mosmann [26] supply us with ample material and references to more material on computer applications and implications for business, education, government, health, environment, humanities and other fields. They discuss the role of computing, discuss the impact of computer technology in our current lives,predict greater impact on our future social, economic and political lives, and provide us with data on public and professional attitudes toward computers. The conclusion drawn by many of these authors has been that knowledge, skills, and attitudes about computers and their impact should be an essential component of pre-college education. In the last few years a variety of organizations have invested time and money in developing computer literacy materials and promoting training, both in Oregon and nationally.

Computer professionals were among the first to call for secondary school training in computer understanding and to recommend programs to achieve computer literacy. As early as 1963, George Forsythe [14], a prominent computer scientist and mathematician, proposed computer education in high school for any student whose future occupation might someday be displaced by a computer.

In 1972, the Conference Board of the Mathematical Sciences [25] concluded that the average citizen has little or no knowledge of how to participate in public issues involving computers. The Board recommended that students be provided with the opportunity to become aware of computers and their applications as part of their formal training. A formal committee of the Association for Computing Machinery (ACM) [1] listed sixteen issues concerning computers and public policy which will soon require the attention of legislative and regulatory bodies. How many of these issues will directly affect average citizens and thus warrant their attention, is not yet determined.

The National Science Foundation [20] is currently studying the feasibility of a national program for computer literacy. A major workshop [2] to define some of the most important societal issues regarding computer use and to formulate an effective program of study and research to achieve public understanding of these issues has been funded by the Foundation.

Judy Edwards [10], a prominent Oregon computer educator and researcher, concludes that the number and variety of computer applications we come into contact with daily makes it essential to develop computer literacy programs. Mike Dunlap and David Moursund [8], two of the state's leaders in computer education, include knowledge of computer occupations in a long list of objectives for a computer literacy course.

Vocational implications of computer technology should be stressed in the school system. Students should be made aware of careers available in the data processing/computing fields and the skills needed for such positions. First, because a large number of jobs have become automated, computerization has changed the skill levels required for maintaining a job as well as for entry into the job market. Secondly, a variety of new positions are created as more businesses and industries purchase or lease computer systems. As computer hardware becomes less expensive to own, more firms will be investing in personnel to operate and maintain their own small computer systems.

The Occupational Outlook Handbook [23], 1976-77 edition, estimates that in 1974, 500,000 persons were employed nationally as computer operating personnel. About 60%, or 300,00 of these are keypunch operators. The Handbook also reports approximately 200,000 computer programmers, 115,000 systems analysts and 50,000 computer technicians.[2] All of these occupations, except keypunch operation, are expected to grow faster than the average for all occupations.

John Hamblen [16], Chairman of the Computer Science Department at the University of Missouri-Rolla, has studied labor statistics related to computer occupations for several years. He estimates the national computer manpower to be 1.4 million with a 10% per year growth factor projected during the seventies. He estimates that there are over 16,000 staff positions in Oregon in the computing field which require at least two years of post-secondary education.

Another Bureau of Labor Statistics publication [6] predicts a 40-60% increase in programmer and system analyst occupations during this decade. The document recommends improvements to computer education, including increases in the number of qualified teachers and more rapid dissemination of information about computer technological advances by educational institutions.

The pervasiveness of computer technology, the policy issues facing our society, and the careers available in the computer field are three good reasons to support the inclusion of computer literacy in Oregon schools. As computer usage increases, more education will be necessary to provide the next generation with the skills to understand and deal effectively with its growth.

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[2] See Appendix D

COMPUTER EDUCATION IN OREGON

During the past ten years, Oregon has developed a solid foundation in computer education. The history of computer education in this state has demonstrated significant growth.

The Computer Instruction Network (CIN) operated a mobile computer system for forty schools in Lincoln, Marion, Polk, and Yamhill counties from 1966 to 1970. A primary goal of the network was to provide a degree of computer awareness to the students in the schools it served.

At about the same time CIN was operational, a handful of high schools in Multnomah County were offering programming courses. A couple of years later, schools in Lane, Umatilla, and Coos Counties began offering programming using the facilities of the Oregon Total Information System. In the fall of 1970, Multnomah Intermediate Education District installed the first computer system dedicated to instructional use. That same year a national study [7] reported that only nine states had greater computer use in high school instruction and administration than did Oregon.

A study specific to Oregon conducted by Cliff Burns in early 1974 for the Oregon Council for Computer Education [5] reported 37% of the high schools representing 65% of the high school population had access to a computer and were using it for instructional purposes. A second (national) study [4] performed in 1975 confirmed that the increase in computer education from 1970 to 1975 was a national trend and predicted that an annual growth rate of 5% per year for computer education will continue into the 1980's.

These figures indicate that Oregon Schools will continue to offer computer-related courses probably to a greater number of students. Established programs in computer literacy will grow and more teachers in more disciplines will be required to teach them.

RECOMMENDATIONS

1. Defining and Assessing Computer Literacy

   Computer literacy will require knowledge of how a computer functions and how it is used, awareness of its products (and by-products), and knowledge of the implications of applying computers to a variety of tasks. This study will recommend a list of specific topics for inclusion in a computer literacy program and will provide a model for assisting a district in defining such a program.

   Specifically, I have identified 46 topics under the headings of computer hardware, computer software, applications, and implications. These topics, presented with a rating scale for determing the level to which each topic might be dealt with to meet the needs of the average high school

graduate, are included in Appendix B. A defensible computer literacy program will be based upon data showing which topics are important and require educational support. We need to know, for example , to what extent a topic such as artificial intelligence needs to be covered by a secondary school computer literacy program. I recommend that the following four projects be undertaken by the Commission:

(1) Identify the computer topics which are relevant to computer literacy as determined by various educational groups (parents, students, teachers, professionals in curriculum and in computer science, etc.)

(2) Identify real-world behaviors likely to be expected of a computer literate person who has completed a computer literacy program.

(3) Design a procedure or an instrument for assessing the competence of a computer literate person.

(4) Publish a computer literacy curriculum guide which reflects the information gathered in 1, 2 and 3 and which includes lists of print and non-print materials catalogued by objectives which would assist a teacher in implementing a computer literacy program.

The instrument included in Appendix B, or something like it, could be useful in completing the first project. The second project will require a study of the amount of computer material we, as citizens, encounter over a period of time and the amount of computer technology encountered by people on a job. The third project is similar to one currently being conducted in Minnesota under NSF sponsorship. Preliminary results of that study should be available by January 1, 1977. The fourth project involves considerable effort in analyzing the results of the first three projects. Some effort has gone into identifying non-print resources for computer education. Ben Jones [17] put together a catalog in 1973 and Karen Beisse and Karen Billings [3] have prepared a list of resources for a national computer education conference scheduled for Portland in October, 1976.

2. Computer Literacy and Existing Course Goals

The introduction of computer literacy into Oregon secondary schools need not wait for the completion of projects leading toward the establishment of a major program. The existing State Department of Education guidelines and models for meeting graduation requirements contain several course goals and indicators of student performance which, if modified to reflect computer technology, would serve as an impetus for including computer literacy objectives into existing programs.

The state department guidelines address the three areas mentioned on page 1: personal development, social responsibility, and career development. Suggested modification to these guidelines are contained in Appendix A.

Personal Development includes communication and computational skills, knowledge of scientific and technological processes, maintenance of health, and development of life-long learning skills. Computers are now involved in many aspects of our personal lives. Personal development education should reflect this. We are often called upon to respond to communications from a computer rather than from a human. Unlike human communications, computer messages, such as utility bills, magazine subscription notices, etc., are low in information content. If your bills are in error, you should have the knowledge necessary to deal with the company with the least possible amount of confusion and harassment. Decoding computer messages and knowing correct steps to take in response to them are skills which should be included in a student's personal development.

Social responsibility includes citizenship and consumer education goals. Not only does computer technology present us with the need for new social policies, but many existing laws and policies need to reflect a computerized society. Without computer literacy, can students, for example, identify differences between the way elections are conducted now and the way they were conducted prior to computerization? Can they identify differences in voter behavior as a result of these changes? Can they list advantages and disadvantages to the changes in the method of conducting elections or the speed with which we obtain results?

Career development education presents a challenge to the Commission. The competencies needed by various occupations to deal with automation are not well defined. In addition, the Career Education Division of the State Department of Education is organized into career clusters, a cluster being defined as related occupations employing at least 10,000 persons in Oregon with 2,000 replacement workers required over the next five years. Each cluster is advised by a committee of educators, employers, and workers in the cluster. The Commission will need to work with each cluster individually to identify areas where computer technology will have an impact on job descriptions and on job skills.

For the secretarial-clerical cluster, for example, competency in coding information into the correct form for computer processing is important. Writing new competencies for existing jobs is not, however, the only solution to computer literacy in career education. It is important that existing performance skills reflect current data processing and computing practices.

For example, a student required to identify electrical careers from a list of occupations (7.2.1.1)[3] should have an opportunity to identify electronics technician or other computer related electronic occupations. A student who is required to operate a cash register (9.2.1) or maintain a perpetual inventory (9.3.3) should have some knowledge of "Point of Sale" technology which may render such skills irrelevant (See Appendix E). In addition to the four projects mentioned earlier, I further recommend that the Commission

(5) Establish liaison with other departments in the State Department of Education, particularly with subject specialists and career education specialists in order to further identify areas where computer literary objectives are appropriate. These should include English, Social Studies, Business Education, Secretarial-Clerical Education, Science, Mathematics and Industrial Mechanical Education.

(6) Work with established Advisory Committees of SDE career clusters to identify competencies related to career education.

3. Teacher Training

The training of teachers for computer literacy should involve both in-service training and pre-service training. Both approaches are related to the problem of whether or not to require a teacher certification norm in computer literacy/computer science.

The first step toward the establishment of a teacher training program is to identify the competencies required of an adequately trained teacher. One approach is to use the same instrument to define computer literate teachers as was suggested for determining computer literate students (Appendix B). A second approach is to examine the background of the two or three dozen computer teachers in Oregon to determine their strengths related to the success of their programs.

Computer education literature contains several suggestions for in-service teacher training programs. Elliot and Peelle [12] list seven general topics to be covered in a course for computer augmented teacher training. They also outline four mathematics-oriented courses. These suggestions are included in Appendix C. Also included in Appendix C is an outline of five computer content areas under discussion for the University of Oregon summer program of computer education for teachers. The program has been described in an article by Moulton and Moursund [21].

Pre-service training for teachers with majors in social science, business, mathematics or physical science has been described in an article by Frederick [13]. The program outlined for this group is heavily oriented toward programming concepts. Another program has been suggested for the computer science major [29]. While both of these programs would adequately prepare a beginning teacher for computer literacy, no single program has yet been designed expressly to fill that need.

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[3] Performance indicator number from Career Development Education, Section IV, Oregon Graduation Requirements

Many of the suggested teacher certification programs are related to pre-service training programs. Two suggested programs are heavily dependent upon a good mathematics background [24,28]. David Moursund [22], however, recommends three types of certification, one of which would be appropriate for the teacher of computer literacy. This certificate would require 24-30 quarter hours of computer science, but Moursund does not specify the course content which would be included. (Appendix C)

With regard to teacher training, I recommend that the Commission

(7) Work with the Teacher Standards and Practices Commission to determine the feasibility of developing norms for computer educators, and computer requirements for norms in other areas.

(8) Develop a list of competencies for teachers of computer literacy as part of an overall approach to teacher training.

(9) Develop further contacts with teacher training institutions to promote computer training now on a voluntary basis.

RESOURCES AVAILABLE

No formal inventory has been taken of computer hardware available to Oregon's secondary schools. Oregon's computer educators, however, are well known and the programs they provide in computer education should be advertised widely by the Commission.

As mentioned previously, the Computer Science Department at the University offers a summer program to train secondary teachers in computer science and computer education. It is possible over a four year time interval to earn a masters degree in Computer Science Education [21]. The program has been around since 1967 and has graduated over a dozen qualified people.

Northwest Regional Educational Laboratory developed many computer instruction materials using federal grant money. As of this writing, the lab shows every indication of reviving the computer technology program. It recently published a computer literacy text called Elements of Computer Careers [11] which may prove suitable for high school use. More publications are expected within the next few months.

The Oregon Council for Computer Education was organized in the Fall of 1971 for the purpose of solving the common problems of computer education shared by a number of Oregon educators. One of the primary activities of this organization is the training of teachers and administrators in computing and computer technology. [18].

The Intermediate Education Districts serving Multnomah, Lane, Clackamas and Jackson Counties have budgeted funds to provide for a computer education specialist to implement computer education in their districts through consultation and planned workshops for teachers, administrators, and students.

The Oregon Museum of Science and Industry in Portland has been offering computer experiences to their patrons for years. The Cooperative Science Museum planned for Lane County has decided that computer activities will be an important component of their educational program. These community resources are a significant part of the overall educational effort.

The Career Information System (CIS) housed at the University of Oregon has probably put more secondary students in contact with computer technology than all other efforts combined. Over 100,000 students have gained information about jobs and about training programs for jobs through the CIS- copyrighted computer programs.

All of these efforts to provide computer education either directly or as a by-product of their real purpose, are valuable assets to a state trying to implement computer literacy. I recommend that the Commission

(10) Establish liaison with each of these groups and actively promote those activities wich are consistent with the goals of the Commission.

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